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Chest X-rays in COPD screening: Are they worthwhile?

G.M.F. Wallace [a,e], J.H. Winter [a,*], J.E. Winter [b], A. Taylor [c], T.W. Taylor [d], R.C. Cameron [d]

[a] *Respiratory Unit, Ninewells Hospital, Dundee DD1 9SY, UK*
[b] *Wallacetown Health Centre, Lyon St., Dundee DD4 6RD, UK*
[c] *Clinical Technology Centre, Ninewells Hospital, Dundee DD1 9SY, UK*
[d] *Radiology Department, Ninewells Hospital, Dundee DD1 9SY, UK*

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Summary
The BTS/NICE COPD guideline recommends a chest X-ray at initial COPD evaluation; this is a grade D recommendation based on expert opinion. We have investigated which pathologies other than COPD are detected by chest X-ray and how they alter management. Dundee smokers aged 40 or over and receiving bronchodilators are assessed for COPD by their practice nurse and offered a chest X-ray if there is no record of a chest X-ray within the previous three years. We retrospectively analysed the chest X-ray reports and case records of these patients. The chest X-ray report was structured with 7 specific questions, most importantly ''Are there any features of other disease likely to be causing dyspnoea?'' and ''Are there any features to suggest lung cancer?'' Management of patients with chest X-ray findings suggesting other disease causing dyspnoea or lung cancer was assessed by questionnaire and case record study.

Five hundred forty-six consecutive chest X-ray reports were analysed. Fourteen percent of all chest X-rays detected potentially treatable dyspnoea causing disease; where management following receipt of X-ray reports was audited, 84% were thought to help. Eleven lung cancers were detected, 3 had stage 1 disease.

Considerable benign and malignant pathology is detected by chest X-ray performed at initial COPD assessment. Clinical management is changed in the majority with a potentially treatable abnormality. This evidence suggests that the NICE guideline to perform chest X-ray at initial COPD evaluation should be elevated from a grade D to grade C recommendation.

* Corresponding author. Tel.: +44 1382 496457; fax: +44 1382 496458.
E-mail address: john.winter@nhs.net (J.H. Winter).
[e] Present address: University Hospital of North Tees, Hardwick Road, Stockton-on-Tees TS19 8PE.

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Introduction

The burden of disease from chronic obstructive pulmonary disease (COPD) is large. It is estimated that up to 1.5 million of the UK population have COPD but the exact prevalence is unknown.[1] The extent of coexisting respiratory disease other than COPD is also unknown. The National Institute for Health and Clinical Excellence (NICE) COPD guidelines[2] and a recent series of articles on the management of COPD recommend that, at the time of initial diagnostic evaluation, all patients should have a chest X-ray to exclude pathologies other than COPD.[3] It is a grade D recommendation, in other words it is based on expert opinion alone not on any published evidence. This study identifies abnormalities on X-rays performed in such circumstances and explores the clinical utility of identifying these abnormalities.

Methods

General practices in Dundee manage a population of approximately 160,000 people; the prevalence of COPD is approximately 2.6% in this population. Since 2000, a management program for patients with COPD has existed, based largely in primary care and managed by trained nurses, with assistance from general practitioners and secondary care when necessary. The population evaluated is aged 40 or more, has a positive or unknown smoking history and is recorded as receiving inhaled bronchodilator therapy and/or having a recorded diagnosis of COPD; for those patients receiving bronchodilator medication without a recorded diagnosis of COPD or asthma an assumption is made that the bronchodilator has been prescribed for general practitioner diagnosed airways disease. These patients are invited to their general practice for screening with spirometry and those with a FEV_1/FVC ratio of $<$70% in whom asthma can be excluded are given a diagnosis of COPD and entered the management program. If there is no record of a chest X-ray in the preceding three years, patients are offered a chest X-ray request form. Patients may then choose to attend the local X-ray facility to have their chest X-ray performed. Either of 2 respiratory radiologists report each chest X-ray in a structured fashion answering 7 specific questions (Table 1). A retrospective analysis of all COPD screening chest X-ray reports for a two-year period from June 2003 until May 2005 was performed by one observer. Following this, case notes were reviewed of all patients found to have screening chest X-rays suggestive of lung cancer. Questionnaires were sent to the appropriate COPD practice nurse regarding patients who were found on chest X-ray to have potentially treatable dyspnoea causing disease other than cancer in order to ascertain whether or not the chest X-ray report altered management in practice. Questionnaires varied slightly depending on what the disease was under investigation (Appendix). The only patients in this category for whom questionnaires were not sent were 3 patients in whom tuberculosis (TB) was queried. This was because it was known that the chest X-ray altered management in these patients as they were all managed in secondary care. The questionnaires were then analysed.

Results

The reports of 546 screening chest X-rays were reviewed. The answers to the 7 questions are shown (Table 1). A total of 50.6% of the patients were male; mean age was 64 years (range 40–88, SD10.8). Complete spirometry data were available in 493 patients; in 100 FEV_1/FVC ratio was $>=$70% and $<$70% in 393; mean %predicted FEV_1 was 63% (consisting of 0.4, 14.8, 28.4, 35.8 and 20.5% for the following ranges of %predicted, respectively, $<$20, 20–$<$40, 40–$<$60, 60–$<$80, $>$80) and mean MRC dyspnoea score 2.6 (consisting of 10.5, 44.9, 21.4, 18.6, and 4.5% in scores 1, 2, 3, 4 and 5, respectively).

Abnormalities other than lung cancer believed to be causing dyspnoea are shown in Table 2 and those unlikely to be causing dyspnoea are shown in Table 3. Of the 106 patients, 76 had potentially treatable disease, namely 51 with lower respiratory tract infection, 8 with bronchiectasis, 6 with pulmonary fibrosis, 4 with pleural effusion, 4 with left ventricular failure, and 3 with possible active TB. Thus 14% of all chest X-rays requested at COPD evaluation detected potentially treatable causes of dyspnoea other than lung cancer and COPD.

Seventy-three questionnaires were sent to the primary care COPD nurses of which 56 were returned. The pathologies represented in the returns were 42 lower respiratory tract infections, 6 bronchiectasis, 3 left ventricular failures, 3 pulmonary fibrosis, and 2 pleural effusions. In 47 of these patients, the COPD nurse felt that the screening chest X-ray had been helpful with management (84%), in 6 felt it was not and in 3 did not know. Lower respiratory tract infection was not suspected in 28 patients prior to their X-ray. Twenty-seven of these were given antibiotics after the X-ray and 24 of the 27 in whom a follow-up chest

Table 1 The 7 questions on the structured chest X-ray report.

Number	Question	Result
1	Is the chest X-ray technically satisfactory?	Yes: 486, No: 60
2	Are the lungs a normal size?	Normal: 290, Large: 244, Small: 12
3	Is the heart a normal size?	Normal: 494, Large: 50, 2 not measurable
4	Is there significant focal emphysema?	Yes: 82 (71 upper zone, 10 lower zone, 3 unspecified)
5	Are there any features to suggest lung cancer?	Yes: 14, No: 532
6	Any features of other disease likely to be causing dyspnoea?	Yes: 106, No: 440
7	Any features of other disease not causing dyspnoea?	Yes: 130, No: 416

Table 2 Numbers of patients with abnormalities likely to be causing dyspnoea.

Abnormalities likely to be causing dyspnoea	No.
Presumed pneumonic shadowing	51
Bronchiectasis	8
Fibrosis	7
Other parenchymal shadowing	5
Cardiac abnormality	12
Thoracic cage or pleural abnormality	12
Pneumonectomy or lobectomy	4
Focal lesions	10
Pleural effusion	4
New TB	3

X-ray was recommended underwent one. The diagnosis of bronchiectasis was unknown in 2 of the 6 patients and led to standard management such as training in drainage. The diagnosis of left ventricular failure, pulmonary fibrosis and pleural effusion was not known in any patient before their X-ray. They received appropriate management following X-ray. Of the 3 patients with possible active tuberculosis 1 had active tuberculosis, another staphylococcal pneumonia and the other pleural thickening.

Lung cancer was confirmed in 9 of 14 patients with COPD and radiological features suggesting this diagnosis on their X-ray. In addition the diagnosis of lung cancer followed a repeat film in 2 of 27 patients in whom a repeat chest X-ray was recommended because of consolidation on the screening chest X-ray. Thus 49.6 chest X-rays were performed to detect 1 lung cancer. The stage and pathology of the carcinomas and treatment given are shown (Table 4). Five patients had potentially curative treatment with 4 of them having surgery. This compares favourably with the local surgical resection rate of 8%.

Discussion

This study has shown that considerable pathology is detected by chest X-ray at initial evaluation of patients for entry into a COPD management program. Fourteen percent of all the COPD screening chest X-rays detected potentially treatable dyspnoea causing disease other than bronchogenic carcinoma and it is known that of the 546 patients, at least 50 (9%) underwent a change in management. In the vast majority of patients the abnormality causing dyspnoea was unknown prior to the screening X-ray. It is possible that our population was biased towards patients with active disease and/or recent onset of symptoms in that these patients may have been more likely to take up the invitation to attend the general practice for screening for respiratory disease and subsequently the invitation to attend for a chest X-ray. Our COPD nurses do not undertake physical examination of their patients attending for COPD screening; physical examination may have identified signs suggesting some of the radiological diagnoses found but it is unlikely that such findings would have reduced the likelihood of recommending a chest X-ray. We are unable to quantify from our data the proportion of patients who took up the invitation to have a chest X-ray but we believe from feedback from our nursing staff that the majority of patients did so.

The extent of some pathologies determined whether or not the reporting radiologist believed it was likely to be causing dyspnoea, thus some of these abnormalities appear in both tables.

A small proportion of patients with COPD are unable to perform spirometry correctly and return a spurious restrictive defect. Our primary care COPD nurses find a comment on the size of the lungs useful in this situation since they have been taught that a patient with an appropriate history and a FEV_1 of less than 50% predicted, taking into account technique, who has normal or large lung volumes on their chest X-ray without additional abnormality is likely to have COPD since plain chest X-rays can be used to quantify total lung capacity[10]; this study derived accurate lung volumes from analysis of postero-anterior and lateral CXRs, but we believe that the volumes derived from an postero-anterior film alone is satisfactory for the purpose of contributing to the diagnosis of a common disease in primary care in a simple and straightforward fashion.

The identification of focal emphysema was included in the standard report since one of the locally agreed criteria for referral to secondary care is the assessment of patients with upper zone emphysema for suitability for lung reduction surgery.

Our detection rate for lung cancer is higher than those seen in the Early Lung Cancer Action Project studies[4–7]. A Cochrane review of screening for lung cancer found no evidence for a survival benefit for screening with chest X-ray, however, the proportion of subjects with COPD in the study populations in the assessed studies was not reported.[8] Approximately 80% of our patient group had evidence of airways obstruction and it is well recognised that COPD predisposes to lung cancer and may be a more potent risk factor than age or smoking level[9]; additionally the characteristics of our population suggest that a number of patients without COPD have been included which would increase the proportion with lung cancer in the group with true COPD. Nevertheless our data are insufficient to support a recommendation to screen potential COPD patients for lung cancer with a chest X-ray.

The quality of radiology reports is a recognised issue.[11] Physicians and radiologists may have different perceptions of

Table 3 Numbers of patients with abnormalities unlikely to be causing dyspnoea.

Abnormalities not likely to be causing dyspnoea	No.
Old TB, other scarring	69
Hiatus hernia, goitre	10
Non-cardiac past surgical intervention	8
Thoracic cage or pleural abnormality	41
Cardiac abnormality	12

Table 4 Bronchogenic carcinomas detected by chest X-ray.

Stage	TNM	Pathology	Treatment
IIIA/IV	T2N2MX	Non-small cell	Palliative chemotherapy (CT)
IIIB	T4N0/2M0	No positive	Palliative CT/radiotherapy (RT)
IIIA	T3N1M0	Squamous	Photodynamic therapy, palliative RT
IV	T3N1M1	Squamous	Palliative CT/RT
IA	T1N0M0	Squamous	Radical RT
IIIA	T2N2MX	Adenocarcinoma	Lobectomy, adjuvant CT
1A	T1N0M0	Non-small cell	Lobectomy
IIIA	T2N2M0	Non-small cell	Lobectomy, refused CT
	Not staged	No positive	Died 3 weeks later
IIIA	T3N1M0	Squamous	Palliative RT, PDT
IB	T2N0M0	Non-small cell	Lobectomy, refused CT

what is important in the report.[12] To address this we defined a set of essential information to be included in the reports prior to the start of the study which was in addition to the routine free text report. Overall our nursing staff find the structured chest X-ray reports more easy to interpret than the usual narrative reports.

Our study does not address whether the arbitrary cut off of having a chest X-ray within the previous three years is appropriate, nor does it provide guidance on how frequently a chest X-ray in COPD patients should be performed in order to be clinically valuable.

This study provides evidence that the NICE guideline for a chest X-ray to be performed at initial COPD diagnostic evaluation identifies pathology in a substantial minority of patients and alters the management in 9% of patients. This evidence supports the guideline being upgraded from a D to a C recommendation.

Conflict of interest statement

None of the authors have any conflict of interest with the content of this paper.

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J.H. Winter, R.C. Cameron, T.W. Taylor and J.E. Winter developed the standardised chest X-ray reporting tool and organised its implementation throughout the Dundee primary care COPD service. A. Taylor developed the program for data collection. G. Wallace, J.H. Winter, and A. Taylor analysed the data. All authors contributed to the writing of the paper.

Other contributors were the practice and COPD nurses who managed the patients, arranged for the Chest-X-rays to be performed and provided feedback on the value of the structured chest X-ray reports in general and the follow up of those patients with active disease. This study was submitted to the chairman of the Tayside Committee for Medical Ethics who ruled that an ethical submission to the committee was unnecessary. This work was performed without any specific funding or sponsorship.

Supplementary material

Supplementary material can be found, in the online version, at doi: 10.1016/j.rmed.2009.07.001.

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